CLAIMS

What is Claimed Is:

1. A micro-actuator assembly for use coupling a slider in a head gimbal assembly, comprising:

a planar micro-actuator providing at least one planar micro-actuator arm for coupling to said slider; and

a vertical micro-actuator coupling with said planar micro-actuator arm; wherein said vertical micro-actuator includes a vertical lead pair;

wherein said vertical lead pairs receiving an electrical stimulus creates a movement of said slider through said planar micro-actuator arm in a vertical direction; wherein said vertical direction is essentially perpendicular to said rotating disk surface;

wherein said planar micro-actuator arm supports movement through said coupling of said slider in a planar direction; and wherein said planar direction is essentially parallel to said rotating disk surface included in a hard disk drive.

2. The apparatus of Claim 1, wherein said planar micro-actuator provides a first planar micro-actuator arm and a second micro-actuator arm, both for coupling to said slider.

3. The apparatus of Claim 2, wherein said planar micro-actuator provides said first planar micro-actuator arm and said second micro-actuator arm, both support said movement of said slider in said planar direction.

4. The apparatus of Claim 3, wherein at least one of said first planar micro-actuator arm and said second planar micro-actuator arm includes a piezoelectric device.

5. The apparatus of Claim 4, wherein said first planar micro-actuator arm includes a first of said piezoelectric devices;

wherein said second planar micro-actuator arm includes a second of said piezoelectric devices.

6. The apparatus of Claim 5, wherein said first planar micro-actuator arm includes said first piezoelectric device coupling to a first of a slider sleeve containing a first of said coupling to said slider;

wherein said second planar micro-actuator arm includes said second piezoelectric device coupling to a second of said slider sleeves contain a second of said couplings to said slider.

7. The apparatus of Claim 3, wherein said first planar micro-actuator arm is electrically coupled in parallel to said second planar micro-actuator arm.

8. The apparatus of Claim 3, wherein said first planar micro-actuator arm is electrically coupled in parallel to said second planar micro-actuator arm to support said movement of said slider in said planar direction when an electrical stimulus is supplied to said electrical coupling of said first planar micro-actuator arm and said second planar micro-actuator arms.

9. The apparatus of Claim 3, wherein said first planar micro-actuator arm is electrically coupled in parallel to said second planar micro-actuator arm.

10. A head gimbal assembly (HGA), comprising said micro-actuator assembly of Claim 1 coupled with said slider using said planar micro-actuator arm and using a coupled flexure to provide said electrical stimulus received by said vertical micro-actuator.

11. An actuator arm mechanically coupling to said head gimbal assembly of Claim 10.

12. An voice coil actuator assembly, including:

at least one of said actuator arms of Claim 11; and

a main flex circuit electrically coupling said flexure included in said actuator arm to provide said electrical stimulus received by said vertical micro-actuator.

13. A hard disk drive, comprising:

said voice coil actuator assembly of Claim 12; and

an embedded disk controller printed circuit board electrically coupling with said main flex circuit to further provide said electrical stimulus received by said vertical micro-actuator.

14. A method of making a head gimbal assembly (HGA), comprising the steps of:

coupling a micro-actuator assembly with a slider using a planar micro-actuator arm and using a coupled flexure to provide said electrical stimulus received by a vertical micro-actuator;

wherein said micro-actuator assembly, includes:

a planar micro-actuator providing said planar micro-actuator arm; and

said vertical micro-actuator coupled with said planar micro-actuator arm; wherein said vertical micro-actuator includes a vertical lead pair;

wherein said vertical lead pairs receiving said electrical stimulus creates a movement of said slider through said planar micro-actuator arm in a vertical direction; wherein said vertical direction is essentially perpendicular to said rotating disk surface;

wherein said planar micro-actuator arm supports movement through said coupling of said slider in a planar direction; and wherein said planar direction is essentially parallel to said rotating disk surface included in a hard disk drive.

15. The method of Claim 14, wherein the step coupling said micro-actuator assembly to said slider is further comprised of the steps of:

coupling said slider using said first planar micro-actuator arm;

coupling said slider using said second planar micro-actuator arm.

16. The method of Claim 15, wherein said planar micro-actuator provides said first planar micro-actuator arm and said second micro-actuator arm, both support said movement of said slider in said planar direction.

17. The method of Claim 16, wherein at least one of said first planar micro-actuator arm and said second planar micro-actuator arm includes a piezoelectric device.

18. The method of Claim 17, wherein said first planar micro-actuator arm includes a first of said piezoelectric devices;

wherein said second planar micro-actuator arm includes a second of said piezoelectric devices.

19. The method of Claim 18, wherein the step coupling said slider using said first planar micro-actuator arm is further comprised of the step of:

coupling said slider to a first of a slider sleeve; wherein said first piezoelectric device is coupled to said first slider sleeve; and

wherein the step coupling said slider using said second planar micro-actuator arm is further comprised of the step of:

coupling said slider to a second of a slider sleeve; wherein said second piezoelectric device is coupled to said second slider sleeve.

20. The method of Claim 16, wherein said first planar micro-actuator arm is electrically coupled in parallel to said second planar micro-actuator arm.

21. The method of Claim 16, wherein said first planar micro-actuator arm is electrically coupled in parallel to said second planar micro-actuator arm to support said movement of said slider in said planar direction when an electrical stimulus is supplied to said electrical coupling of said first planar micro-actuator arm and said second planar micro-actuator arms.

22. The method of Claim 16, wherein said first planar micro-actuator arm is electrically coupled in parallel to said second planar micro-actuator arm.

23. A method of making an actuator arm, comprising the step of mechanically coupling said actuator arm to said head gimbal assembly of Claim 14.

24. Said actuator arm as a product of the process of Claim 23.

25. A method of making a voice coil actuator assembly, comprising the step of:

electrically a main flex circuit electrically coupling said flexure included in said actuator arm of Claim 23 to provide said electrical stimulus received by said vertical micro-actuator.

26. Said voice coil actuator assembly as a product of the process of Claim 25.

27. A method of making a hard disk drive, comprising the step of:

electrically coupling an embedded disk controller printed circuit board electrically coupling with said main flex circuit of Claim 25 to further provide said electrical stimulus received by said vertical micro-actuator.

28. Said hard disk drive, as a product of the process of Claim 27.